Candidate style answers

Introduction to quantitative reasoning

High banded responses

Introduction

This resource has been produced by a senior member of the Core Maths examining team to offer teachers an insight into how the assessment objectives are applied. It has taken questions from the sample question paper and used them to illustrate how the questions might be answered and provide some commentary on what factors contribute to overall levels.

As these responses have not been through full moderation, they are banded to give an indication of the level of each response. Please note that this resource is provided for advice and guidance only and does not in any way constitute an indication of grade boundaries or endorsed answers.

The sample assessment material for these answers and commentary can be found on Teach Cambridge Core Maths - Core Maths A (MEI) Level 3 Certificate - H868 and Core Maths - Core Maths B (MEI) Level 3 Certificate - H869.

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Question 1 (a)

The table shows exchange rates displayed at a bank in England.

(a) How much will 200 Euros cost a customer in English pounds?

[3]

Sample answer for question 1 (a)

1.14 Euros = £1

$\frac{200}{1.14}$ = £175.4386

£175.44 to the nearest 1p

Commentary on the answer

This answer uses the correct exchange rate of changing pounds to euros and performs the correct calculation to do the conversion. The answer is correctly rounded to the nearest penny.

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Question 1 (b)

(b) A watch is priced at $58.50 US dollars.

Calculate an estimate of the cost of the watch in English pounds.

Use the exchange rates in the table.

Show your calculations **and** any approximations you make.

[3]

Sample answer for question 1 (b)

£1 is about $1.50. The watch is about $60.

60 ÷ 1.50 = 40

so about £40

Commentary on the answer

This answer uses a sensible approximation for both the exchange rate between dollars and pounds and for the price of the watch. Both are clearly stated which is in line with the need to show any approximations made. Correct working leading to a correct answer in pounds is also shown.

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Question 2

The Earth travels round the Sun once a year.

The average distance of the Earth from the Sun is 1.5×10^{11} m.

Assume that the Sun remains still and ignore the rotation of the Earth about its axis.

(a) What assumption must be made about the path of the Earth to estimate its average speed from the information given?

[1]

(b) Calculate an estimate the Earth's average speed.

Give your answer in **km h^{-1}**.

Give your answer to an appropriate degree of accuracy.

[5]

Sample answer for question 2

(a) The Earth's path is circular.

(b) Radius of the circular path = 1.5 x 10^{11} m

Distance travelled (circumference of the circle) = $2 \times \pi \times 1.5 \times 10^{11}$

Speed = $\frac{\text{Distance}}{\text{Time}} = \frac{2 \times \pi \times 1.5 \times 10^{11}}{365} =$ 2 582 130 948 metres per day

= 2 582 131 km per day

= 2 582 131 ÷ 24 = 107 589 km/hr

108 000 km/h

Question 3 (a)

This question is based on the article in the **pre-release material**, **'**Caring for the elderly'.
A clean copy of the pre-release material is provided as an Insert.

A home care worker takes a new job through an agency.
They travel to elderly people's homes to provide care for them.
They are with each client for either 15 minutes or half an hour.

Here is a summary of their first day at work:

Morning (am):
- 7am - set off to see first client
- journey to first client takes half an hour
- with first client for 15 minutes
- journey to second client takes half an hour
- with second client for 15 minutes
- arrive home at 12 noon having seen a total of six clients, two for 15 minutes each and four for half an hour each.

Afternoon (pm):

- 5pm - set off for evening visits
- journey to first client takes 20 minutes
- arrive home at 7pm, having seen a total of four clients for 15 minutes each.

(a) The agency pays the care worker £7.30 an hour for the time they are with clients.
The agency does **not** pay the care worker for any time travelling.

How much does the agency pay the care worker for their first day?

[2]

Sample answer for question 3 (a)

6 people for 15 mins = 90 mins = 1.5 hrs

4 people for 30 mins = 2 hrs

3.5 hrs at £7.30 per hr = £25.55

Commentary on the answer

This answer correctly identifies the number of people seen for 15 mins and for 30 mins. Working is shown clearly and is correct, leading to a correct answer.

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Question 3 (b) (i)

(b) Another agency pays home care workers for time with clients **and** time travelling between clients.

They do **not** pay for time travelling to or from home.

That agency pays £6.31 an hour.

(i) Which of these is the most appropriate estimate of the care worker's total time travelling to and from home on their first day at work?

Tick (ü) one box.

30 minutes ☐

50 minutes ☐

1 hour 40 minutes ☐

3 ½ hours ☐

[1]

Sample answer for question 3 (b) (i)

7am to 12pm = 5 hrs, 5pm - 7pm = 2 hrs, 5 + 2 = 7 hrs in total.

7 hours less 3.5 hours with clients = 3.5 hours travelling.

In the morning, 30 mins travel from home but unknown return journey time.

In the evening, 20 mins travel from home but unknown return journey time.

More than 50 minutes but less than 3.5 hours, so 1 hr 40 mins is the best estimate.

Commentary on the answer

This question only requires a tick box selection, so this is an illustration of the process taken to arrive at the answer.

The answer is correct and correctly reasoned from the given information. Not all the travelling time to and from home is provided but all the other options can be ruled out.

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Question 3 (b) (ii)

(ii) Work out how much the second agency would pay the care worker for their first day at work.

Use your answer from **(b)(i)**.

[3]

Sample answer for question 3 (b) (ii)

7 hrs less 1 hr 40 for travel = 5 hrs and 20 mins.

5 × 6.31 = £31.55

6.31 ÷ 3 = £2.10 (nearest 1p)

Total = £33.65

Total = £33.65

Commentary on the answer

This answer correctly works out the time with clients and time travelling between clients by subtracting the time the care worker was travelling to and from home, (from (b)(i)), from the total time she was away from home. The amount paid is then calculated correctly using the hourly rate of £6.31. The correct method is clearly shown and recognises 20 minutes as one third of an hour.

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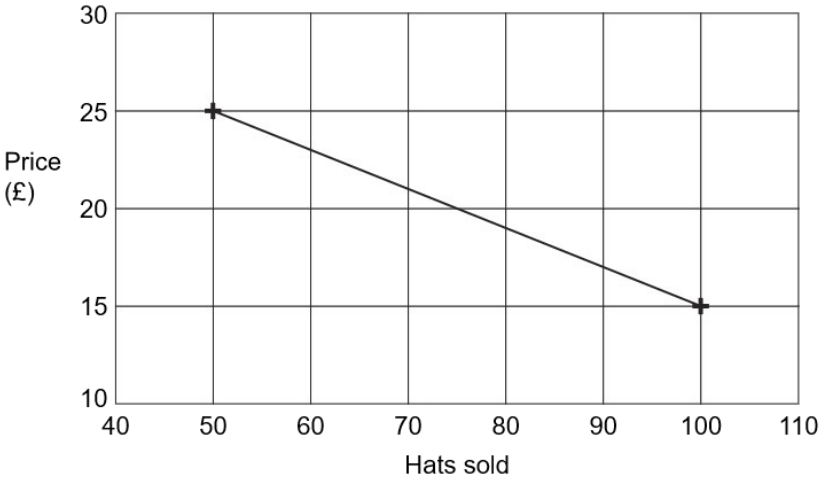
Question 4 (a)

Heidi sets up a business making hats.
She needs to decide how much to sell the hats for.
Each hat costs her £3 to make.
She can make up to 100 hats per week.

Heidi has done market research which suggests:

- she can sell 100 hats per week if she charges £15 for each hat
- she can only sell 50 hats per week if she charges £25 for each hat.

The graph shows the demand curve modelled as a straight line.



She uses this model and a spreadsheet to find the price for the hats that will give her the maximum profit.

The table opposite shows the spreadsheet she uses.

(a) Complete **column B** of the table by filling in the missing numbers.

	A	B	C	D
1	**Price (£)**	**Hats sold**	**Cost (£)**	**Profit (£)**
2	15	100	300	1200
3	16			
4	17		270	1260
5	18			
6	19			
7	20		225	1275
8	21			
9	22			
10	23		180	
11	24		165	
12	25	50	150	

[2]

Sample answer for question 4 (a)

	A	B	C	D
1	**Price (£)**	**Hats sold**	**Cost (£)**	**Profit (£)**
2	15	100	300	1200
3	16	95		
4	17	90	270	1260
5	18	85		
6	19	80		
7	20	75	225	1275
8	21	70		
9	22	65		
10	23	60	180	
11	24	55	165	
12	25	50	150	

Commentary on the answer

The correct numbers in the linear sequence have been filled in, using the given start and end numbers to find the common difference between the 10 missing terms: (100 – 50) ÷ 10 = 5.

Question 4 (b)

(b) What formula should be in cell C2 so that it can be copied down the column to give the cost in each row?

[2]

Sample answer for question 4 (b)

= 3*B2

Commentary on the answer

This answer gives a correct formula, correctly expressed in terms of spreadsheet cell references and it remembers to include the equals sign at the start.

Question 4 (c)

(c) What formula should be in cell D2 so that it can be copied down the column to give the profit in each row?

[2]

Sample answer for question 4 (c)

= A2*B2-C2

Commentary on the answer

This answer gives a correct formula, correctly expressed in terms of spreadsheet cell references and it remembers to include the equals sign at the start.

Question 4 (d)

(d) What price should Heidi sell the hats for to make the maximum profit?

The price of the hats needs to be a whole number of pounds.

[4]

Sample answer for question 4 (d)

	A	B	C	D
1	Price (£)	Hats sold	Cost (£)	Profit (£)
2	15	100	300	1200
3	16	95	285	1235
4	17	90	270	1260
5	18	85	255	1275
6	19	80	240	1280
7	20	75	225	1275
8	21	70	210	1260
9	22	65	195	1235
10	23	60	180	1200
11	24	55	165	1155
12	25	50	150	1100

£19 is the selling price for maximum profit.

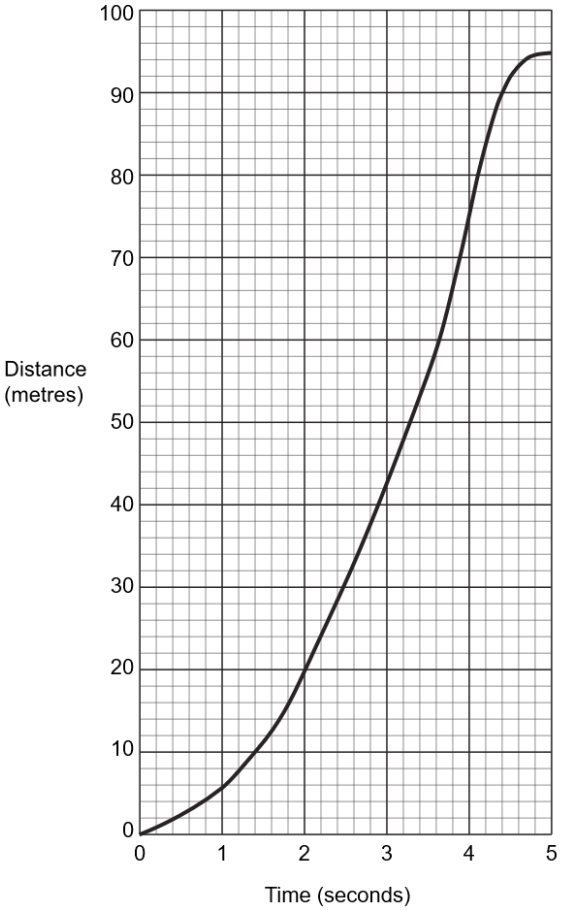
Commentary on the answer

This answer correctly calculates the costs and profits and then correctly identifies the selling price to achieve the maximum profit.

Question 5 (a)

A cheetah is the fastest land animal.

a) The graph shows the motion of a cheetah over five seconds.



(i) At what time is the cheetah travelling the fastest?

[1]

(ii) Calculate an estimate of the cheetah's maximum speed over these 5 seconds.

Use the graph. **[3]**

Sample answer for question 5 (a)

(i) The steepest part of the graph is from 3 seconds to 4 seconds.

(ii) Distance at 3 seconds is 42 m and at 4 seconds the distance is 74 m.

32 m travelled in one second, so speed is 32 m/s.

Commentary on the answer

i. The answer has recognised that the fastest speed occurs at the steepest part of the graph.

ii. The gradient for this section is estimated correctly by approximating the graph for a short section by a straight line. An alternative approach

Question 5 (b)

(b) Two websites give the maximum speed of a cheetah.

- One website says that the maximum speed of a cheetah is 50 metres per second.
- The other website says that the maximum speed of a cheetah is 70 miles per hour.

Determine whether these two speeds are approximately the same.

Show your reasoning.

Use 5 miles $\approx$ 8 km.

[4]

Sample answer for question 5 (b)

70 ÷ 5 × 8 = 112 km per hour

112 km = 112 000 m

So, 112 000 metres per hr is the same as: 112 000 ÷ 60 ÷ 60 = 31.1 m/s

No, they are not the same.

Commentary on the answer

This answer uses a correct strategy of changing the speed in miles per hour to metres per second so that they can be compared. The correct conversion from

miles per hour to km per hour has been made and then the speed in metres per second has been found.

Question 6 (a)

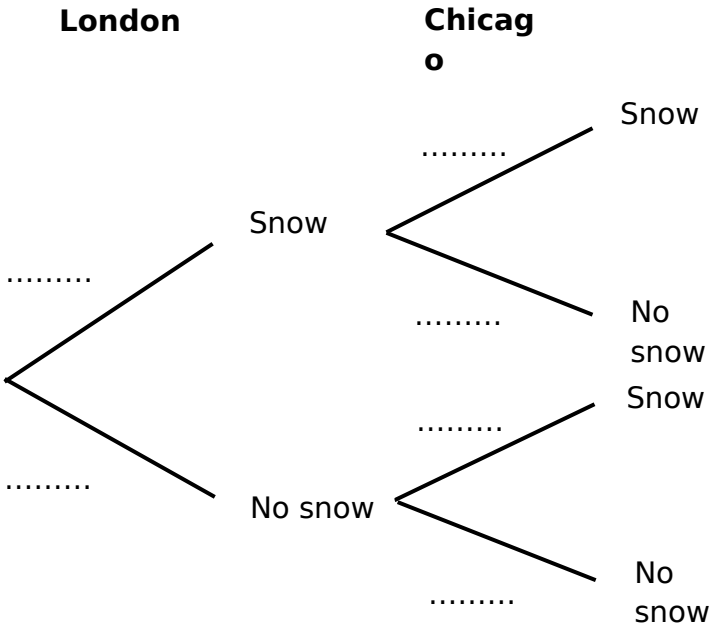
(a) A plane flies from London to Chicago.

The weather forecast for the day of the flight shows that:

- the probability of snow in London is 60%
- the probability of snow in Chicago is 80%.

Assume the weather in London and Chicago are independent of each other.

(i) Complete the tree diagram.



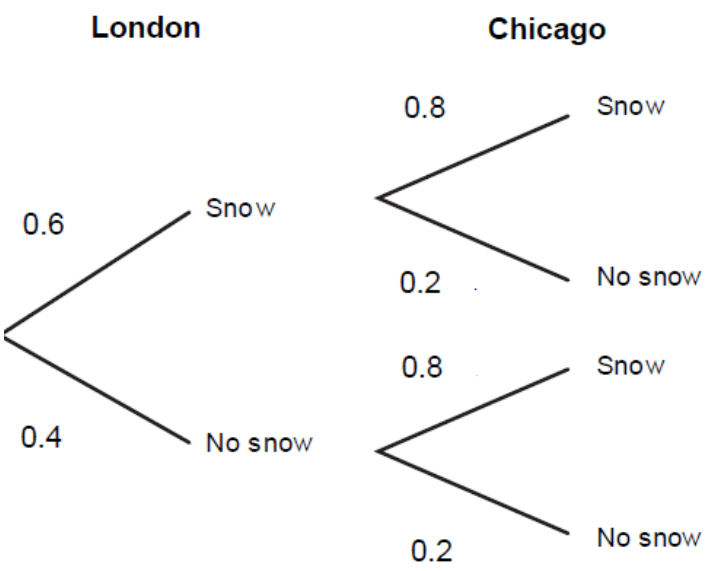
[3]

(ii) Calculate the probability that there will be snow in at least one of these two places on the day of the flight.

[2]

Sample answer for question 6 (a)

(i)



(ii) $(0.6 \times 0.8) + (0.6 \times 0.2) + (0.4 \times 0.8)$

$0.48 + 0.12 + 0.32 = 0.92$

or 92%

Commentary on the answer

i. The tree diagram is completed correctly.

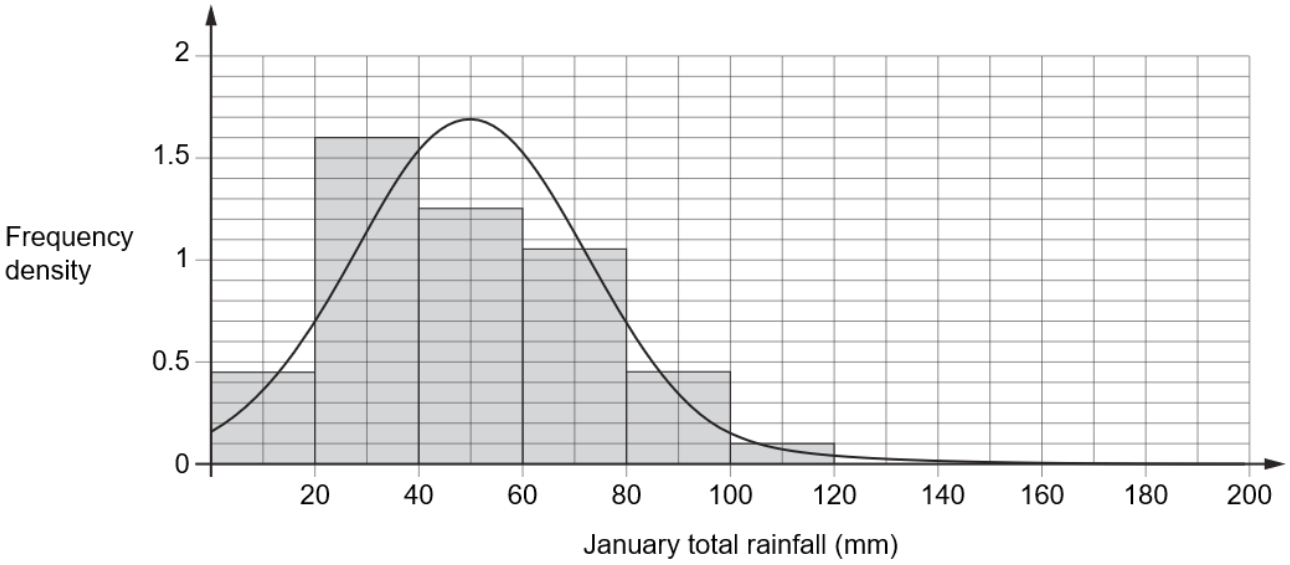
ii. All the probabilities of snow in at least one of the two places have been extracted from the tree diagram to calculate the correct probability. An alternative approach would be to calculate the probability of no snow in either of the two places and subtract from 1.

Question 6 (b)

(b) The histogram shows the distribution of January rainfall near an English town for 98 years.

A Normal distribution has the same mean and standard deviation as the rainfall data.

The diagram shows part of this Normal curve.



(i) Use the Normal curve to work out an estimate of the mean of the rainfall data.

[1]

(ii) Use the Normal curve to calculate an estimate of the standard deviation of the rainfall data.

[2]

(iii) Give **two** reasons to reject the Normal distribution as a model for the rainfall data.

[2]

Sample answer for question 6 (b)

(i) The mean is about 50 mm

(ii) The standard deviation is about $\frac{(140 - 50)}{3} =$ 30 mm.

(iii) The distribution of the rainfall data is skewed.

The Normal curve shows that there would be some negative values of rainfall to get the full Normal curve, but it is not possible to get rainfall below zero.

Commentary on the answer

i. The answer has correctly identified the mean as being where the Normal curve has a maximum.

ii. The answer for the standard deviation is correct, recognising that almost all the data should be in the range (mean +/- 3sd).

iii. The answer gives two correct reasons for rejecting the Normal distribution.

Question 7 (a) (i)

(a) The population of the world in 1960 was 3040 million.

The population of the world in 1975 was 4090 million.

Models A and B are two different models for the population growth.

(i) In model A the population grows by a constant **number** of people each year.

Show that the average increase from 1960 to 1975 is 70 million people per year.

[2]

Sample answer for question 7 (a) (i)

$\frac{4090 - 3040}{15} = 70$

so, the increase is 70 million

Commentary on the answer

This answer correctly works out the constant annual increase in millions.

Question 7 (a) (ii)

(ii) In model B the population grows by a constant **percentage** each year.

What constant annual percentage growth rate from 1960 to 1975 would result in the population increasing from 3040 million to 4090 million?

Show your working.

[3]

Sample answer for question 7 (a) (ii)

$4090 = 3040 \times x^{15}$

$\sqrt[15]{\frac{4090}{3040}} = x$

$x = 1.019$

so, 2%

Commentary on the answer

This answer correctly calculates the annual percentage increase, recognising that the multiplier would be used 15 times to get to the 1975 population.

Question 7 (a) (iii)

(iii) The population of the world in 2000 was 6090 million.

Determine which of the two models is better.

Show your reasoning.

[5]

Sample answer for question 7 (a) (iii)

Using model A, 25 × 70 = 1750 million extra since 1975, so 4090 + 1750 = 5840 million

Using model B, $4090 \times 1.02^{25} = 6710.07$

From these figures Model A looks closer to the actual figure of 6090 million; model A is 250 million out, but model B is 620 million out.

Commentary on the answer

This answer uses both model A and model B correctly to work out an estimate of the population in the year 2000. The answer uses these figures to correctly decide that model A more accurately predicts the population in 2000. It would also have been reasonable to conclude that neither model is ideal.

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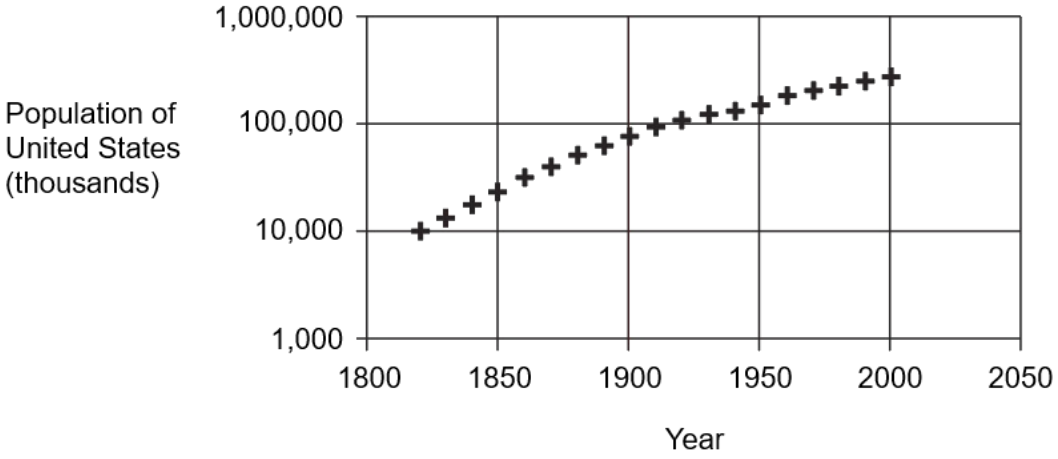
Question 7 (b)

(b) The chart shows the population of the United States, in thousands, from 1820 to 2000.

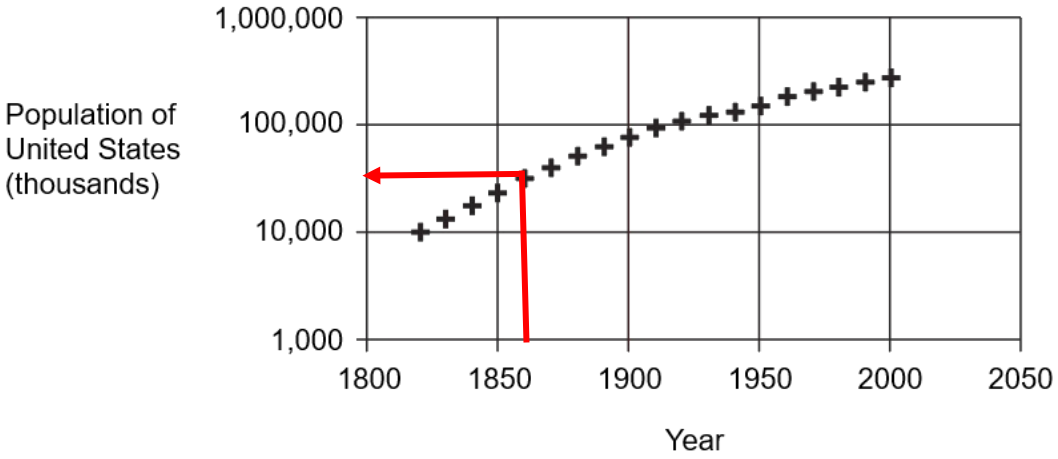


The vertical axis has a logarithmic scale.

What was the approximate population of the United States in 1860?

[3]

Sample answer for question 7 (b)



The correct answer is halfway between 10 000 and 100 000 on the vertical axis.

So $\sqrt{10\,000 \times 100\,000} = \sqrt{1\,000\,000\,000}$ = 31 622.7766

31.6 million

Commentary on the answer

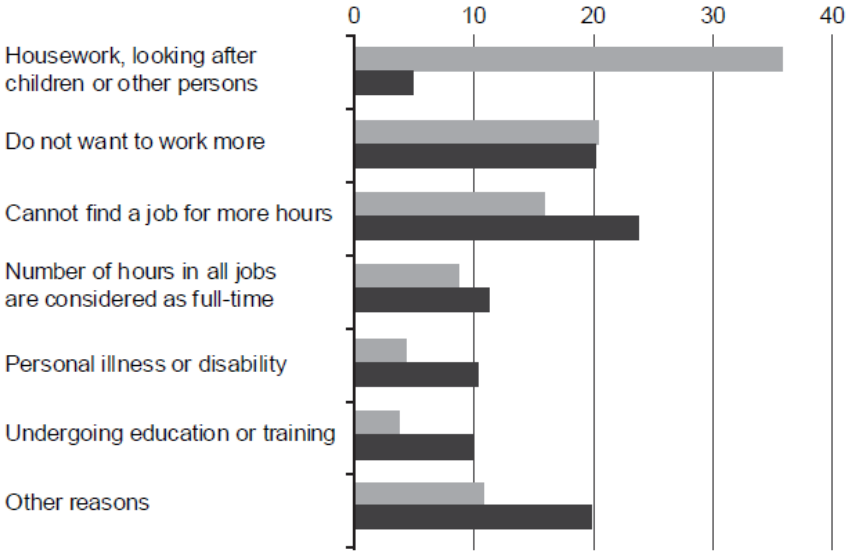
This answer correctly identifies the point corresponding to 1860 and realises that it is approximately halfway along the scale between 10 000 and 100 000. The correct value is then calculated using the geometric means because the vertical scale is

logarithmic. The fact that the vertical scale is in thousands is also taken into account when giving the final answer which is rounded sensibly.

Question 8 (a)

Men and women in the European Union who work less than 30 hours per week were asked why they work less than 30 hours per week.

The chart shows the results of this survey in percentages.



(a) Suggest **one** way that the graph could be improved to show the information more clearly.

[1]

Sample answer for question 8 (a)

Add more divisions on the vertical scale to help when reading off values.

Commentary on the answer

One reasonable improvement is suggested in this answer, and it is clearly stated.

Question 8 (b)

(b) Each woman responding to this survey gave only one reason.

Show that the men responding to this survey also choose only one reason each.

[3]

Sample answer for question 8 (b)

If men gave more than one reason, the percentages would add up to more than 100%.

The percentages from the graph are:

5 20 23 12 10 10 20

The percentages total to 100 so everyone answered just once.

Commentary on the answer

A correct strategy is explained and followed through to a correct conclusion. It isn't possible to read exactly from the graph so percentages close to the ones given in this answer and adding up to close to 100% would also be acceptable.

Question 8 (c) (i)

(c) There are four times as many women as men working less than 30 hours per week in the European Union.

(i) Show that approximately 5% of people surveyed (men and women combined) gave the reason 'undergoing education or training'.

[2]

Sample answer for question 8 (c) (i)

$$\frac{4\times4+1\times10}{5}=\frac{26}{5}\approx5\%$$

Commentary on the answer

The working in this answer is correct and it is related to the given answer of 5%.

Question 8 (c) (ii)

(ii) Find the corresponding percentage that gave the reason 'housework, looking after children or other persons'.

[2]

Sample answer for question 8 (c) (ii)

$\frac{4}{5}$ of 35 plus $\frac{1}{5}$ of $5 = 29\%$

so approximately 30%

Commentary on the answer

Correct working is shown, leading to a correct answer (within the allowable range given the accuracy of the graph scale), following the same method as was used in part (i).

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Question 9 (a)

A typical ant is about 5 mm long and weighs about 3 mg.

An actor has a height of about 2 m and weighs about 80 kg.

(a) How many times smaller is the length of the ant in comparison to the height of the actor?

[1]

Sample answer for question 9 (a)

2 m = 2000 mm

2000 ÷ 5 = 400

The man's height is 400 times the ants.

Commentary on the answer

This answer correctly converts metres to millimetres and works out the scale factor for length between the ant and the man.

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Question 9 (b)

(b) A science fiction film script includes shrinking the actor to 5 mm tall.

As the actor shrinks, their weight is directly proportional to their volume.

Compare the weight of the 5 mm tall actor to the weight of the ant.

[4]

Sample answer for question 9 (b)

The man's volume would be divided by 400^3 as he shrunk to the size of the ant. The same would happen to his weight.

So 80 kg = 80 000 g = 80 000 000 mg

$$\frac{80\ 000\ 000}{400^3} = 1.25 \text{ mg}$$

The actor is less than half the weight of the 3 mg ant.

Commentary on the answer

This answer correctly cubes the length scale factor to get the volume scale factor between the ant and the man. The scale factor for volume is correctly used to get the man's shrunk weight. The weight of the actor is correctly calculated in mg and then compared with the weight of the ant in the same units. An appropriate final comment is given.

Summary of updates

Version (Date of issue)	Section	Change
Version 1.0 (03/2023)		
Version 2.0 (11/2025)		Our Sample Assessment Materials have been updated as part of our accessibility principles and to reflect our live assessment materials. These resources are based on the Sample Assessment Materials, so some questions have been restructured or re-worded and the candidate style responses have been revised accordingly.

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